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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/871,463	05/31/2001	Charles R. Spinner III	01-P-002 (STM101-00013)	9805
30425	7590	09/20/2006	EXAMINER	
STMICROELECTRONICS, INC. MAIL STATION 2346 1310 ELECTRONICS DRIVE CARROLLTON, TX 75006			WARREN, MATTHEW E	
			ART UNIT	PAPER NUMBER
			2815	

DATE MAILED: 09/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/871,463

Applicant(s)

SPINNER ET AL.

Examiner

Matthew E. Warren

Art Unit

2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 7/10/06.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☐ Claim(s) _____ is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) _____ is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This Office Action is in response to the RCE and Amendment filed on July 10, 2006.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 16-20 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification and drawings do not disclose that "an upper surface of the tungsten having an arcuate shape across substantially all of the width of the opening." For instance, it seems that claim 16 pertains to the embodiment of the applicant's figure 2B. In figure 2B, the upper surface of the tungsten (201) is coplanar with the dielectric (100) and therefore has a planar shape across the width of the opening. Furthermore, the specification does not disclose how much of the upper surface of the tungsten layer is occupied by the arcuate shape. If the applicant is trying to imply that the portion of the tungsten layer having the etch protective barrier (202) is the arcuate shape, then that portion does not seem to be across all of the opening or even most of the opening. The way the limitation is written implies that the arcuate shape is across the entire opening. If such is the case, then the

etch protective barrier (202) which also forms the arcuate shape in question would not be over only a central region of the tungsten. Further more, the term "substantially" in the claims is a relative term of degree and such a term does not properly describe how much of the width of the tungsten layer is occupied by the arcuate shape. At best, figure 2B shows that an upper surface of the tungsten layer has an arcuate shape across a portion of the width of the opening. Therefore, the claim limitation in question will be interpreted as follows:

"an upper surface of the tungsten having an arcuate shape across a portion of the width of the opening."

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 8-15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 8 recites the limitation of "a conformal tungsten layer over the dielectric layer and within and filling any unfilled portions of openings within the dielectric layer; and an etch protective barrier layer over the tungsten layer and within the openings." The limitation is indefinite because the applicant is trying to imply that nothing else fills the opening of the dielectric but tungsten, while at the same time trying to imply that the etch protective barrier layer is also within the openings. The limitations of claim 8 are

described in the embodiment of the applicant's drawing figures 1A and 1B. In those figures, the tungsten layer (107) completely fills the openings (102, 103, 104), but etch protective barrier (109) is not within the opening. The etch protective barrier is above the opening of the dielectric (100). Therefore, for purposes of examination, the limitations in question will be understood as follows:

"a conformal tungsten layer over the dielectric layer and within and filling any unfilled portions of openings within the dielectric layer; and an etch protective barrier layer over the tungsten layer and directly above the openings."

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 16-19, as far as understood, are rejected under 35 U.S.C. 102(b) as being anticipated by Suzuki et al. (US 6,054,383)

In re claim 16, Suzuki et al. shows (fig. 2C) a portion of an integrated circuit structure comprising: a dielectric layer (4) having an opening, tungsten (8a) within the opening, an upper surface of the tungsten having an arcuate shape (U-shaped depression described in col. 5, lines 55-67) across a portion of the width of the opening, and a portion of an etch protective barrier layer (10a) over a central region of the tungsten and within the opening, but not over peripheral regions of the tungsten. The

protective barrier layer has the property of a material for which removal of chemical mechanical polishing is primarily mechanical (col. 6, lines 59-65) .

In re claim 17, Suzuki et al. shows (fig. 2C) that an upper surface of the tungsten is exposed around a portion of the protective barrier layer.

In re claim 18, Suzuki et al. discloses (col. 5, lines 62-67) that the protective barrier layer is titanium or titanium nitride.

In re claim 19, Suzuki et al. shows (fig. 2C) that the tungsten and the portion of the protective barrier layer form an upper surface, which is planar with an upper surface of the dielectric layer.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 8-11, 13, and 14, as far as understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Marcyk et al. (US 6,103,625) in view of Suzuki et al. (US 6,054,383).

In re claim 8, Marcyk et al. shows (fig. 2B) a portion of an integrated circuit comprising: a dielectric layer (202) over a substrate, a conformal tungsten layer (206) over the dielectric layer, within and filling any unfilled portions openings within the dielectric layer. An etch protective barrier (208) of tungsten is formed over the tungsten

layer and directly above the openings. Marcyk shows all of the elements of the claims except the etch protective barrier comprising a material for which removal by chemical mechanical polishing is primarily mechanical. Suzuki et al. shows (fig. 2B) a portion of an integrated circuit structure comprising: a dielectric layer (4) having an opening, tungsten (8a) within the opening, and an etch protective barrier layer (10a) over the tungsten. The etch protective barrier layer is a TiN layer and has the property of a material for which removal of chemical mechanical polishing is primarily mechanical (col. 6, lines 51-65). By using this material, the conductive layer is effectively prevented from being chemically etched by chemicals during the CMP process. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the etch protective barrier of Marcyk by using a material for which removal by CMP is primarily mechanical (such as TiN) as taught by Suzuki to prevent the underlying conductive layer from being etched away chemicals during the CMP process.

In re claim 9, Suzuki discloses (col. 5, lines 62-67) that the etch protective barrier is titanium nitride.

In re claim 10, Suzuki shows (fig. 2B) that the portions of the tungsten layer within the openings are thicker than the portions of the tungsten layer over the dielectric layer.

In re claim 11, Marcyk shows (fig. 2B) that the etch protective barrier layer (208) overlies the entire tungsten layer (206).

In re claims 13, neither reference specifically discloses the thickness within the desired range, however, it would have been obvious to one of ordinary skill in the art to make the thickness of the tungsten layer within the desired range, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. One of ordinary skill in the art would have been motivated to form the tungsten have the thickness within the desired range to form the device having specific dimensions.

In re claim 14, Suzuki discloses (col. 6, lines 1-2) that the protective barrier layer has a thickness of 0.05 microns (500 Angstroms), which is between 100 and 800 Angstroms.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Marcyk et al. (US 6,103,625) in view of Suzuki et al. (US 6,054,383) as applied to claim 8 above, and further in view of Van Buskirk et al. (US 6,346,741 B1).

In re claim 15, Marcyk and Suzuki show all of the elements of the claims except the opening in the dielectric being sized to form a capacitive electrode from the tungsten within the opening. Van Buskirk et al. shows. (fig. 1H) shows a capacitor device comprising a tungsten electrode contact (18) and a tungsten top electrode (44) formed in dielectric layer (18 and 35) openings. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the tungsten interconnect of Marcyk and Suzuki by incorporating that interconnect as a capacitor

electrode because Van Buskirk teaches that tungsten interconnects suitably function as capacitor electrodes.

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. (US 6,054,383) as applied to 16 above, and further in view of Van Buskirk et al. (US 6,346,741 B1).

In re claims 20, Suzuki et al. shows all of the elements of the claims except the opening in the dielectric being sized to form a capacitive electrode from the tungsten within the opening. Van Buskirk et al. shows. (fig. 1H) shows a capacitor device comprising a tungsten electrode contact (18) and a tungsten top electrode (44) formed in dielectric layer (18 and 35) openings. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the tungsten interconnect of Suzuki by incorporating that interconnect as a capacitor electrode because Van Buskirk teaches that tungsten interconnects suitably function as capacitor electrodes.

Allowable Subject Matter

Although claim 12 is rejected above under 35 USC 112, the claim contains allowable subject matter. If the 112 Rejection is overcome, the claims would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

Applicant's arguments with respect to claims 8-15 have been considered but are moot in view of the new ground(s) of rejection.

Applicant's arguments filed with respect to claims 16-20 have been fully considered but they are not persuasive. The applicant primarily asserts that the prior art references do not show all of the elements of the claims, specifically that Suzuki does not show the added limitation of the upper surface of the tungsten layer having an arcuate shape across the entire width. As stated in the 112 Rejection above, the specification does not show proper support for that added limitation. In light of what the specification discloses, the examiner interprets the new limitation to mean that the upper surface has an arcuate shape across a portion of the width of the tungsten layer (as shown in applicant's figure 2B). That being the case, Suzuki discloses (col. 5, lines 55-57) that the tungsten layer has a depression (8a) that is filled with TiN layer (10). The depression is described as having the cross section of a "U" character. If something is shaped like a "U" then it has an arcuate shape. Therefore, Suzuki discloses the limitations in question and ultimately shows all of the elements of the claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew E. Warren whose telephone number is (571) 272-1737. The examiner can normally be reached on Mon-Thur and alternating Fri 9:00-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew E. Warren



September 16, 2006